U.S. Environmental Protection Agency research and technical support needs related to conceptual model development for subsurface reactive transport modeling of inorganic contaminants, radionuclides, and nutrients

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1 INTRODUCTION

The U.S. Environmental Protection Agency (USEPA) currently supports research through its Office of Research and Development (ORD) in the following high priority areas:

- Contaminated Sediments
- Ground Water Remediation
- Waste Characterization, Leaching, Reuse
- Arsenic
- Ecosystem Restoration
- Bioavailability (in support of risk assessments)

All of these areas utilize or could benefit from advancements in reactive transport modeling.

1.1 Specific areas of need for reactive transport modeling advancements

The following specific areas within the National Risk Management Research Laboratory (NRMRL) of USEPA/ORD can benefit from advancements in conceptual model development for subsurface reactive transport modeling of inorganic contaminants, radionuclides, and nutrients:

- performance assessment and site characterization for monitored natural attenuation of contaminants in the subsurface,
- performance assessment of reactive caps or monitored natural recovery for the treatment of contaminated sediments (in situ)
- conceptual models for prediction of contaminated sediment transport and contaminant bioavailability during resuspension events
- performance assessment of permeable reactive barriers for ground water remediation,
- improvements in speciation modeling, particularly for complex mixed waste sites, and
- improvements in conceptual model development for and modeling the transport of arsenic in subsurface systems and from wastes and waste products
- improvements in modeling the transport and fate of nitrogen in subsurface systems.

2 EPA/ORD CLIENTS

EPA's Office of Research and Development is responsible to EPA's Office of Solid Waste to provide research and technical support for waste site closures and the development of technical guidance in support of environmental regulations and programmatic policies. ORD is also responsible to EPA's regional offices to provide technical assistance for Superfund and RCRA cleanups. Many of these sites involve inorganic contaminants. Adequate site conceptual models are often lacking at many of these sites due to inadequate data, improper interpretation of data, lack of understanding and/or use of reactive transport models for site assessment purposes, and other factors.

2.2 Major sources of inorganic contaminants, radionuclides, nutrients as stressors for environmental programs

In terms of overall costs for remediation and restoration of sites impacted by inorganics (including radionuclides and nutrients), the most significant stressors (excluding air deposition) are Department of Energy (DOE) waste sites, abandoned mine lands, and agriculture. A recent top-to-bottom review of the DOE Environmental Management Program identified the following wastes and materials at DOE sites scattered around the country:

- 25 tons of plutonium
- 108 tons of plutonium residue
- 88 million gallons of radioactive liquid wastes
- 2500 tons of spent nuclear fuel
- 137,000 cu. meters of transuranic wastes
- 1.37 million cu. meters of low level wastes

The estimated life-cycle liability costs for managing these wastes exceed 200 billion dollars.

A recent EPA Office of Inspector General Report identified 156 hardrock mining sites nationwide that have the potential to cost between $7 billion and $24 billion to clean up (at a maximum total cost to EPA of approximately $15 billion). These costs are over 12 times EPA's total annual Superfund budget of about $1.2 billion for the last five years.

Another area of increasing focus is research on ecosystem restoration. While the majority of the focus here is on surface water quality, issues related to ground water – surface water interactions and sediment loading are also important. Non point source pollution from urban runoff, concentrated animal feeding operations, and agricultural practices have been identified as key stressors, with nitrogen management an increasingly important component of many restoration efforts. Nutrient management plans are often proving to be inadequate in controlling the transport of nitrogen, phosphate and other nutrients into receiving streams. It is possible that the conceptual models and transport models being used to assess nitrogen transport for these types of sites are inadequate.

The challenge confronting the USEPA, like many government agencies, is how to leverage scarce and shrinking resources to improve our capabilities in site conceptual model development and the development of improved reactive transport models for site assessment, reme-